Effect of tectonic loading on continental rifting: Imaging, quantification and linkage of deep-seated flow and surface deformation

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Here we use dynamically scaled analogue experiments to investigate the influence of tectonic loading on continental rifting. Analogue models consist of a two-layer brittle-viscous set up overlying a foam base, which expands homogeneously when extension is being applied perpendicular to the rift axis trend. A layer of quartz sand on top of a viscous silicone/corundum sand mixture layer is used as an analogue for an upper brittle crust and a ductile lower part of the crust, respectively. An additional package of sand on one part of the model simulates tectonic loading.

The aim of this work is to investigate in detail dynamic rift propagation in such a setting by means of a fully quantitative monitoring of surface and internal deformation, focusing on rift propagation velocity, growth rate and orientation. The evolution of the surface topography (DEM) and deformation (3D displacement field) is monitored and quantified using 3D Digital Image Correlation (3D stereo DIC). Furthermore, we apply an automated fault segment tracer on the surface deformation data to characterize rift evolution. Model internal deformation is investigated by digital volume correlation (DVC) techniques applied on X-ray computed tomography data of the time-series experiment volumes. With the use of such techniques we are able to visualize, quantify and link deep-seated internal flow and surface deformation over time.

Preliminary results from these experiments suggest that rift propagation in our analogue models is directly influenced by load-induced deep-seated deformation resulting in a horizontal lower-crustal flow opposing rift propagation.